

Intrinsic Motivation Inventory: An Adapted Measure for Schizophrenia Research

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part of a cognitive remediation protocol or psychosocial rehabilitation program.

Key words: schizophrenia/motivation/assessment/rehabilitation

This article describes the psychometric validation of a scale designed to measure intrinsic motivation (IM) in schizophrenia. Recent studies have highlighted the relationship between motivation and functional outcome in schizophrenia and identified IM as an important mediating factor between neurocognition and psychosocial outcome. It therefore becomes imperative to have validated measures of IM for empirical use. To that end, we validated a self-report IM scale that gauges the central motivational structures identified by Self-determinism Theory as pertinent to cognitive task engagement, skill acquisition, treatment compliance, and remediation outcome. Participants were schizophrenia outpatients involved in a cognitive remediation study ($n = 58$), a convenience subsample of clinically stable schizophrenia outpatients ($n = 15$), and a group of healthy normals ($n = 22$). The Intrinsic Motivation Inventory for Schizophrenia Research (IMI-SR) is a concise instrument, possessing good internal consistency ($\alpha = .92$) and test-retest reliability (intraclass correlation = .77). Data were analyzed to abridge the original 54 items into a final 21-item questionnaire comprised of 3 domains relevant to motivation for treatments (interest/enjoyment, perceived choice, value/usefulness). The scale was highly associated with germane constructs of motivation for health-related behaviors, including perceived competency for attempting challenging tasks and autonomous treatment engagement. Importantly, the scale was able to distinguish improvers and nonimprovers on a cognitive task and actual learning exercises, delineate high vs low treatment attendance, and demonstrate sensitivity to motivational changes due to intervention variation. The IMI-SR is a viable instrument to measure IM in schizophrenia as

Introduction

Empirical studies have identified a number of components that play a significant role in the psychiatric rehabilitation of schizophrenia.^{1–4} Factors consist of a range of pharmacologic, neurocognitive, vocational, and social cognitive mechanisms that all contribute to symptomatic and functional improvements in schizophrenia.^{5–10} Although conceptual models and empirical findings have underscored the association between symptomatology, neurocognition, and functional outcome,^{11–15} very little has been published about the interplay between neurocognitive recovery and the psychological states that influence the remediation process. Since Medalia et al¹⁶ posited that intrinsic motivation (IM) and its associated derivatives play a central role in cognitive recovery and overall psychiatric rehabilitation, this mechanism has started to receive more empirical examination.

IM distinctively differs from extrinsic motivation that depends on external reinforcement such as subject payment or performance certificates.¹⁷ Although all motivation is based on some reward variation, external, tangible reinforcement or internal fortifications (ie, self-satisfaction), the underpinnings of IM, emphasize autonomy and competence by means of choice, control, and an interpersonally supportive climate.¹⁸ When patients are intrinsically motivated for a treatment, they engage in targeted behaviors because of the interest, enjoyment, and satisfaction derived from their engagement in the activity, rather than due to external rewards. Thus, intrinsically motivated behaviors are repeated without external rewards or constraints and, therefore, more likely to be maintained within a treatment setting. This is especially relevant to developing treatments in schizophrenia because experiences of external reward and reinforcement are diminished, as patients demonstrate deficits in the performance of tasks where positive feedback is provided to guide performance.^{19–22}

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In conceptualizing schizophrenia symptomatology, IM is a critical element underlying a cluster of motivational deficits that include negative symptoms such as inertia, anhedonia, and avolition.²⁰ Anhedonia specifically has been linked to deficits in the hedonic experience of anticipatory pleasure (enjoyment related to the anticipation of future activities) and deficient motivational processes, leading to social isolation and decrements in goal-directed treatment behaviors.²³ In a review of evidence-based cognitive remediation approaches for schizophrenia, motivation is noted to be one of the key targets of intervention in order to maximize cognitive remediation outcome.²⁴ Moreover, a recent study by Nakagami et al²⁵ examining mediating factors of psychiatric rehabilitation highlighted the strength of the relationship between IM and psychosocial functioning by suggesting that IM can directly promote neurocognitive improvement and that IM is vital to treatment strategies for improving functional abilities in people with schizophrenia.

As such, investigations are emerging that isolate the role of IM in clinical treatments and their relationship to cognitive remediation^{24,26,27} and occupational therapy outcomes.²⁸ Given the promising attention to IM, there is a need to provide a reliable instrument to assess IM in empirical trials in schizophrenia. To date, there exists no instrument in schizophrenia to assess this construct for treatment-related tasks and the implications for specific treatment outcome. The mentioned study by Nakagami et al²⁵ developed a rather unique and inventive technique to gauge motivation by summing pertinent intrapsychic deficit items from the Quality of Life Scale (QLS)²⁹ probing purpose, motivation, and curiosity. However, given the query parameters of the QLS, their method is cross-situational rather than task or treatment specific. In addition, constructs highly relevant to IM in motivational science, such as perceptions of choice, interest, and task value, were not available to them. Therefore, they state that there is still a need for a measure of IM that can be used to evaluate specific intervention outcome in schizophrenia.

To that end, we validated an Intrinsic Motivation Inventory for Schizophrenia Research (IMI-SR) as part of a larger neurocognitive remediation study that examined central motivational structures pertinent to cognitive task engagement, effort on remediation tasks, degree of skill acquisition, treatment compliance, and remediation outcome.

Original IMI

The original IMI³⁰ is a multidimensional self-report, Likert-type rating scale used to assess motivational structures for targeted activities such as sports, school, medical procedures, and laboratory tasks.^{31–34} There are total of 6 subscales and 54 items that gauge subjective experiences of interest/enjoyment, effort, value/usefulness, pressure/tension, relatedness, and perceived choice (ie, “I enjoy

doing this activity very much,” “I think I am pretty good at this activity”). These domains are based on the Self-determinism Theory (SDT) of motivation^{18,35} that postulates that people with internal locus of control feel self-determined to follow through with an activity because they see their behavior as stemming from their own choices, values, and interest rather than a controlling external force. The original scale has been previously tailored for a wide range of activities in nonpsychiatric samples (college students, athletes, etc), but this is the first psychometric adaptation for a neuropsychiatric population. Given the variability of what constitutes motivation in various settings and populations, the authors encourage that the instrument be validated for a specific population to examine its relevance and utility.^{31,33}

Methods

Participants

Participants in the study were (a) 58 outpatients, aged 18–55 years, diagnosed with schizophrenia/schizoaffective disorder enrolled in a cognitive remediation protocol; (b) a comparable convenience subsample of 15 outpatients with schizophrenia/schizoaffective disorder not involved in the remediation protocol; and (c) a normative sample of 22 nonpsychiatric support staff personnel/hospital volunteers at the 2 performance sites who volunteered to complete the questionnaires and interviews. Participants with schizophrenia were recruited as part of the larger cognitive remediation study at the Veterans Affairs Connecticut Healthcare System, West Haven, CT, and the Audubon Clinic and Lieber Schizophrenia Research Center at the New York State Psychiatric Institute, New York, NY. Prior to participation in the study, participants had to be psychiatrically stable for at least 30 days on any psychotropic regimen. Diagnosis was confirmed by the Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) Axis I Disorders.³⁶ Any participants with significant auditory/visual impairment, lack of fluency in English, or medical illnesses known to impair brain function, other than schizophrenia, were excluded. Participants who met criteria for current substance abuse/dependence were also excluded, including those with active substance abuse 30 days prior to intake.

Procedures

A description of the study was given to all participants who provided written informed consent in accordance with each respective hospital Institutional Review Board. The IMI was administered to a total of 73 schizophrenia outpatients (58 subjects in a treatment study and 15 subjects tested as a convenience subsample) and a comparative normal sample ($n = 22$) with a range of sociodemographic backgrounds (table 1). The schizophrenia treatment sample

Table 1. Demographic and Clinical Characteristics of the 3 Study Samples

	Normals, <i>n</i> = 22, <i>M</i> (<i>SD</i>)	Schizophrenia Subsample, <i>n</i> = 15, <i>M</i> (<i>SD</i>)	Schizophrenia Remediation Sample, <i>n</i> = 58, <i>M</i> (<i>SD</i>)	<i>F</i> Value	Significance (<i>P</i> Value)
Age (y)	39.24 (7.18)	42.34 (8.54)	38.21 (9.23)	0.41	.42
Education (y)	13.57 (2.04)	12.01 (3.03)	11.25 (5.96)	0.23	.77
Gender, male (%)	64	71	65	$\chi^2 = 0.26$.48
Duration of illness (y)	—	9.64 (8.17)	11.43 (9.29)	0.34	.62
Percentage on atypicals	—	94	89	$\chi^2 = 0.33$.37
Percentage diagnosed with disorganized type	—	7	5	$\chi^2 = 0.21$.74
Percentage diagnosed with schizoaffective disorder	—	63	57	$\chi^2 = 0.26$.48
IMI (0–147)	89.27 (9.26)	57.60 (17.47)	61.14 (16.83)	1.56	.03 ^a
BPRS					
Positive factor	—	29.52 (10.02)	30.16 (12.34)	0.57	.36
Negative factor	—	13.55 (3.43)	14.79 (7.11)	0.27	.72
Agitation-mania factor	—	18.18 (6.76)	14.78 (4.98)	0.81	.12
Depression-anxiety factor	—	16.27 (4.19)	17.01 (5.52)	0.39	.40
Total	—	58.46 (19.20)	65.19 (16.30)	0.54	.33

Note: IMI, Intrinsic Motivation Inventory; BPRS, Brief Psychiatric Rating Scale expanded version total score and 4-factor solution.
^aPost hoc: Tukey HSD multiple comparison is significant at 0.03.

was enrolled in a study that directly compared 2 methods of computer-based arithmetic learning, one method incorporated an intrinsic motivational learning approach into arithmetic lessons while another method carefully manipulated out the motivational techniques in the same arithmetic learning program. Details of the remediation study procedures and results are being reported elsewhere, but for purposes of this psychometric study, we provide a brief description of the remediation study methods.

Following baseline testing on all measures, participants were randomly assigned to 1 of the 2 learning programs for ten 30-minute sessions to be completed during a 4-week period. Importantly, participants could work on the lessons at their pace. A research assistant conducted 4 sessions a week where participants were allowed to come in anytime during those sessions to work on the lessons. Within 2 days of the last lesson, posttesting on all measures was completed by a research assistant blind to the randomization.

Instrumentation

In addition to the IMI, the following established measures were included as part of the treatment outcome and psychometric battery.

Estimated IQ. The estimation of premorbid and current IQ in schizophrenia is uniquely complicated due to the deviations from general population means in schizophrenia.^{37,38} Although reading scores are relatively consistent with educational history in schizophrenia patients with

even considerable cognitive impairment,^{39,40} research suggests that brief tests of reading alone may not provide an accurate measure of intellectual functioning in schizophrenia,⁴¹ and the addition of another index, specifically the vocabulary subtest of the Wechsler Adult Intelligence Scale (WAIS), may produce more accurate estimates of both premorbid and current IQ in schizophrenia.³⁹ Therefore, estimated IQ for each participant was established with the vocabulary subtest from the WAIS-Revised and the Wide Range Achievement Test-Third Version (WRAT3) reading subtest.

Attention. Baseline and changes in vigilant attention were measured by a computerized Continuous Performance Test (CPT),⁴² a widely studied instrument in neuropsychology. The Continuous Performance Test-Identical Pairs (CPT-IP) Version^{43,44} is a modification of the standard CPT by Rosvold et al.⁴⁵ and has been used extensively in schizophrenia research.⁴⁴ CPT-IP taps the capacity to sustain focus on critical information in an attention-demanding visual environment and includes well-established norms for a wide range of populations in schizophrenia.⁴⁶ The CPT-IP serially presents 2 types of stimuli (numbers and nonsense shapes) that appear for 50 milliseconds in the center of the screen at a rate of 1 stimulus per second. The participant is instructed to respond as quickly as possible by pushing a control button whenever 2 identical stimuli are presented simultaneously. Major indices analyze performance by number of correct responses to target trials,

false positives, random errors, discriminability, and response bias. The CPT-IP and premorbid IQ measures were used to establish a cognitive baseline profile of the schizophrenia sample and also to provide supplementary divergent support for the IMI because IM does not seem to be correlated with baseline cognitive performance in schizophrenia.⁴⁷

Perceived Competency. The perception of self-efficacy is a central constituent of IM and strong predictor of high levels of motivation in educational and treatment settings.⁴⁸ To assess this specific construct, a brief questionnaire called the Perceived Competency Scale (PCS)³³ was used to assess the participant's outlook on completing and mastering the learning exercises. The PCS consists of 4 item items on 7-point Likert-type scale ranging from "not at all true" to "very true" (ie, I feel confident in my ability to learn the computer program; I am able to achieve my goals in this program). The questionnaire has shown high validity in repeated studies examining its factor loadings related to internalized motivation and interest and possesses excellent internal consistency (Cronbach $\alpha = .80-.94$).³³

Treatment Self-regulation. The Treatment Self-regulation Questionnaire (TSRQ)⁴⁹ was used to ascertain why participants engaged in cognitive remediation and followed the treatment regimen.^{33,49} The degree of autonomous behavior for a treatment regimen is highly correlated to IM. If a person's motivation for health behaviors is relatively autonomous, then motivation for achievement is internally driven, and the probability of successfully completing treatment is dramatically increased.³³ The TSRQ consists of 18 items on 7-point Likert-type scale ranging from "not at all true" to "very true." Items query as to why the participant entered and continued in the program (ie, I decided to enter this learning program because people told me to; I have agreed to follow the procedures of the program because I believe they will help me solve my problem). The TSRQ possesses high reliability and internal consistency in studies examining motivation for psychotherapeutic treatments and continued program attendance (Cronbach $\alpha = .80-.87$).^{33,49,50} Both the PCS and TSRQ were used to establish the IMI's convergent validity.

Symptoms. Psychiatric symptomatology was measured by the widely used expanded Brief Psychiatric Rating Scale (BPRS),^{51,52} an updated version of the original BPRS.⁵³ The expanded BPRS is a 24-item, self-report measure that quantifies the level and presence of psychopathology on a 7-point Likert-type scale ranging from "not present" to "extremely severe." We parsed the BPRS into the standard 4-factor solution of the 24-item BPRS⁵⁴ to examine symptoms categories and

their possible relationship to motivation. Given the conceptual overlap between motivation and negative symptomatology, the BPRS negative symptom factor score was used to investigate the IMI's convergent validity.

Direct Learning. Arithmetic skill was measured by a 48-item paper-and-pencil arithmetic test. This general test supplied by the Columbia University Teacher's College is used to assess general arithmetic ability for purposes of learning remediation in young adults.⁵⁵⁻⁵⁷ It comes in 4 alternative forms to address possible "training-to-test" effects and evaluates the participant's knowledge and calculation skills in addition, subtraction, division, multiplication, use of parentheses, and order of operations [eg, "(4 + 5) × 5 = ___"]. Baseline arithmetic ability and direct learning in arithmetic were measured by the total number correct on tests.

Item Modification, Reduction, and Selection

The authors of the original scale encourage adaption of the items for use in different populations and specific activities. However, because this was a scale without any psychometric corroboration for use in psychosis or an impaired patient population, initial scale item reduction, selection, and retest reliability analyses were conducted with a comparative subsample of schizophrenia patients and a group of normals with similar sociodemographic characteristics (table 1). Both groups were administered the IMI twice, 4 weeks apart, and interviewed to field test the original scale's preliminary utility. To mimic conditions of the actual treatment provided to the remediation group, the subsample and normal groups were briefly shown a computerized mathematics-learning exercise each time and instructed to complete the IMI in the context of attempting the mathematics lesson.

The first step in adapting the scale was to ensure that each item was easy to read and clearly understood by psychotic patients with at least a fourth-grade reading level. This is a frequently overlooked psychometric step when adapting an instrument typically used in normals to an impaired patient population. Items consisting of vocabulary or grammar structure beyond the fourth-grade reading level were rewritten for clarity and understandability and readministered to the schizophrenia subsample to elicit accurate responses. For the items in question, participants were asked to read the items out loud and summarize the content of each item. To further ensure that items were being understood by the schizophrenia subsample, reverse-score items were generated and inserted into the working draft of the scale to corroborate consistent response patterns.

Secondly, the original scale developers acknowledge that items within the subscales overlap considerably, and items can be eliminated based on sample needs

and clinical utility. To reduce patient burden and make this scale as concise as possible, we condensed the scale by presenting to the normal sample all the redundant items in the same domain. Research staff interviewed the sample to inquire as to which item presented the query in the most easily understood format. The items ranked by normals as the easiest to comprehend were noted and compared in the reliability/validity analyses to determine if similar items within the same domain would be retained for the final scale.

The third step in item selection was to remove the items deemed less salient to participants involved in cognitive remediation or psychiatric rehabilitation. Items in the relatedness subscale were eliminated based on feedback from the schizophrenia subsample and normals as irrelevant and/or difficult to answer in the context of a treatment program (ie, "I really doubt that this person and I would ever be friends"). Consistent with the original literature on the scale, these items are primarily used to assess friendship formation and not therapeutic alliance and the least validated with the construct of IM.^{32,58}

The final step with this schizophrenia subsample and normal group consisted of internal consistency and test-retest reliability analyses. Because these participants were readministered the IMI approximately 4 weeks apart with no intervention in between, we were able to confirm past reports^{31,32} regarding the scale's high test-retest reliability. The 4-week interval was chosen in accordance with the expected time line of the treatment sample to complete the remediation protocol.

These initial steps were taken to reduce unnecessary items and make the questionnaire as easy to complete as possible for this impaired population, thereby increasing the likelihood that participants were completing the form in the desired manner. Reducing patient burden is paramount to obtaining accurate information, especially when there is concern about using burdensome self-report measures in schizophrenia. Although one alternative is to adapt the IMI into an interview-based measure, the construct of IM is such that subjective judgments are essential to obtaining an accurate reflection of motivational processes, and researcher ratings would not be able to exploit this psychological structure in another person without a range of interfering partialities.

Of note, past research with the original IMI suggests that order effects of item presentation appear to be negligible³²; so item and domain order was randomly set. The working draft of the IMI assembled for reliability and validity procedures with the schizophrenia treatment sample (IMI-SR) consisted of 30 self-report items measuring interest/enjoyment, effort, value/usefulness, pressure/tension, and perceived choice. Items were on a 7-point Likert-type scale with responses ranging from "not at all true" to "somewhat true" to "very true" and a higher total score reflecting greater IM for a specified task.

Statistical Analysis

To estimate test stability, intraclass correlation coefficients (ICCs) were calculated with the convenience of schizophrenia subsample and normals following a 4-week interval. To adapt the items to an internally and factorially consistent set, all items were subjected to a principal component analysis with varimax rotation. The IMI-SR was evaluated for internal consistency (Cronbach α), and then convergent, divergent, discriminate, and predictive validities were analyzed as a function of relationship values to other theoretical motivational constructs (Pearson product-moment correlation) and comparisons to the normal group on baseline self-reports of competency and IM. Paired *t* tests were also conducted for pre-post mean outcome scores to examine the scale's sensitivity to changes in participants' reports of IM relative to treatment conditions. Finally, to examine predictive validity, the strength of association between categorized IMI-SR scores and outcome variables (odds ratio) were calculated to compare improvers and nonimprovers on outcome measures by treatment assignment and baseline scores.

Results

Overall, total sample characteristics are consistent with previous cognitive remediation trials in schizophrenia but with a majority of psychotic participants diagnosed with schizoaffective disorder (table 1). The 30 items of the IMI-SR required approximately 3–5 minutes to complete, and based on participant feedback, all items were clear and easy to understand with minimal patient burden. Importantly, no significant differences were evident on demographic or baseline clinical variables between the 2 treatment conditions in the remediation study or between the treatment sample and convenience subsample (table 1).

Reliability

In the 2 schizophrenia samples, there was no association between the IMI-SR total score and age ($r = .15$), education ($r = .012$), duration of illness ($r = .08$), diagnoses of disorganized type ($\chi^2 = .26$, $P = .70$), and typical or atypical antipsychotic regimen ($\chi^2 = .31$, $P = .67$). Cronbach alpha showed good internal consistency for the IMI-SR total score ($\alpha = .80$) and subscales of interest/enjoyment ($\alpha = .95$), choice ($\alpha = .89$), and value/usefulness ($\alpha = .91$). Alpha scores for the effort items were slightly below acceptable levels ($\alpha = .70$) and considerably below acceptable levels for pressure/tension ($\alpha = .54$). If effort and pressure/tension subscales were removed from the dataset, the alpha for the IMI-SR total score became increasingly stronger ($\alpha = .92$).

Table 2 shows the ICC between test and retest for total and subscale scores in the schizophrenia convenience

Table 2. Test-Retest Reliability Results on the IMI-SR for Schizophrenia Subsample ($n = 15$) and Normals ($n = 22$) Following a 4-wk Interval

	ICC	SEM
Schizophrenia subsample		
IMI total score	.77	0.49
Interest/enjoyment	.74	0.50
Effort	.68	0.60
Pressure/tension	.25 ^a	0.91
Choice	.76	0.54
Value/usefulness	.70	0.61
Normal sample		
IMI total score	.85	0.17
Interest/enjoyment	.77	0.19
Effort	.71	0.21
Pressure/tension	.72	0.21
Choice	.72	0.20
Value/usefulness	.80	0.17

Note: IMI-SR, Intrinsic Motivation Inventory for Schizophrenia Research; ICC, intraclass correlation coefficient. ^aUnsatisfactory test-retest reliability.

subsample and normal group following a 4-week interval. ICCs generated were acceptable for both populations, except for the pressure/tension subscale in the schizophrenia subsample. The pressure/tension subscale showed inconsistency across this time interlude even when no intervention was provided. If the pressure/tension subscale was removed from the data in the schizophrenia subsample, ICC for the IMI-SR total score increased to .83, nearly matching the high test-retest reliability in the normal group.

Validity

Convergent and Divergent Validity. IMI-SR total scores and subscales of interest/enjoyment, choice, and value/

usefulness correlated moderately, but significantly, with the motivational measures of PCS and the TSRQ, both constructs highly related and germane to IM in the motivational sciences literature (table 3).^{33,35} Of note, the IMI-SR interest/enjoyment subscale had higher correlations with PCS and TSRQ than the IMI-SR total score. The pressure/tension subscale was not correlated to PCS or TRSQ, and the effort subscale was only marginally correlated to PCS and unexpectedly to CPT-IP *d'* (table 3). Somewhat surprisingly, we did not find a significant correlation between BPRS negative symptoms and the IMI-SR. The interest/enjoyment subscale of the IMI-SR was nearly inversely correlated with BPRS negative symptoms ($r = -.18, P = .06$), but no IMI subscale was correlated with the BPRS total score or any of the other symptom factor scores (positive symptoms, $r = .09, P = .12$; agitation-mania, $r = .11, P = .10$; depression-anxiety, $r = .17, P = .07$).

Divergent validity was supported by the lack of correlation between the IMI-SR and CPT-IP indices (target trials, $P = .23$; false positives, $P = .19$; random errors, $P = .11$), WRAT3 reading, and WAIS vocabulary because there is no theoretical or empirical reason for the IMI-SR to be correlated with any of these cognitive measures.

Factor Analysis. Prior to analysis, the data for the variance-covariance matrix were evaluated for univariate or multivariate outliers. An outlier was defined as a leverage score 5 times greater than the mean leverage. No outliers were detected. A confirmatory factor analysis was then conducted to test the construct validity of the IMI-SR and the factor structure that has been found in previous studies with normals.³¹ Three factors emerged with eigenvalues greater than one, accounting for 65% of the variance. Table 4 shows the loadings, eigenvalues,

Table 3. Pearson Correlations Between IMI-SR and Outcome Measures for Entire Schizophrenia Sample (Remediation Group, $n = 58$, and Convenience Subsample, $n = 15$)

	PCS	TSRQ	BPRS Total	BPRS Neg	BPRS Pos	CPT-IP	WRAT3 Reading	WAIS Vocabulary
IMI-SR total score	.46**	.43**	.10	.15	.11	.13	.12	.13
Interest/enjoyment	.52**	.48**	.11	-.18	.10	.13	.13	.10
Effort	.22*	.15	.12	.11	.12	.19*	.10	.10
Pressure/tension	.17	.15	.08	.15	.14	.11	-.12	.10
Choice	.33**	.31**	.11	.14	.10	.10	.12	.15
Value/usefulness	.32**	.38**	.15	.12	.10	.11	.13	.12

Note: PCS, Perceived Competence Scale; TSRQ, Treatment Self-regulation Questionnaire; BPRS Total, Brief Psychiatric Rating Scale expanded version total score; BPRS Neg, Brief Psychiatric Rating Scale-negative symptoms factor; BPRS Pos, Brief Psychiatric Rating Scale-positive symptoms factor; CPT-IP, Continuous Performance Test-Identical Pairs Version, *d'*; WRAT3 reading, Wide Range Achievement Test-Third Version, reading subtest standard score; WAIS-R vocabulary, Wechsler Adult Intelligence Scale-Revised, vocabulary subtest scaled score.

* $P < .05$.
** $P < .01$.

Table 4. Rotated Factor Loadings, Eigenvalues, and Percentage Variance for the Schizophrenia Sample ($n = 73$)

Subscale and Items	Factor 1	Factor 2	Factor 3
Interest/enjoyment			
I enjoyed doing this activity very much	.85	.12	.22
This activity was fun to do	.80	.19	.14
I think this is a boring activity (R)	.64	.07	.01
I would describe this activity as very interesting	.83	.12	.11
I thought this activity was quite enjoyable	.78	-.15	.19
I was thinking about how much I enjoyed it	.67	.16	.04
This activity does not hold my attention at all (R)	.72	.11	.17
Effort			
I put a lot of effort into this ^a	.03	.42	.40
I tried very hard on this activity	.16	.23	.27
It was important to me to do well at this task	.12	-.15	-.04
I did not try very hard on this activity (R)	.10	.18	.02
I put a lot of energy into this	.09	.03	.18
Pressure/tension			
I did not feel nervous at all while doing this	.05	.13	.22
I was very relaxed in doing these	.01	.34	.19
I did not feel pressured to do this	-.14	.06	.02
I felt very tense while doing this activity (R)	.19	.10	.05
Choice			
I believe I had some choice about doing this activity ^a	.25	.83	.41
I felt like it was not my own choice to do this task (R)	.14	.53	.02
I really did not have a choice to do this activity (R) ^a	.08	.47	.59
I feel like I had to do this	.16	.48	.12
I did this activity because I wanted to	.19	.63	-.13
I had a choice to do this activity or not	.21	.52	.17
I did this activity because I had to (R)	.16	.41	.23
Value/usefulness			
I believe this activity could be of some value to me	.19	.35	.76
I think that doing this activity is useful	.10	.36	.68
I think this is important to do	.20	.26	.74
I would be willing to do this again ^a	.16	.40	.82
I think doing this activity could help me	.04	.28	.81
I believe doing this activity could be beneficial to me	.18	.23	.39
I think this is an important activity	.18	.06	.45
Eigenvalue	3.21	1.66	1.50
Variance explained (%)	35	16	14

Note: R, reverse scored. Items loading on 2 factors were excluded if they were less than .40 or there was less than .10 difference between the loadings. Bolded numbers indicated the significant loadings on the factors.

^aItems that loaded on more than one factor.

and variance explained for the rotating factors. The factors were interpreted as interest/enjoyment (factor 1), perceived choice (factor 2), and value/utility (factor 3). Consistent with psychometric validation studies of the original IMI with athletes and school children,^{31,32} interest/enjoyment items (factor 1) accounted for the majority of the explained variance (35%), with each item possessing strong primary loadings for the relevant factor (>.60) and appropriately low secondary loadings. If items with loadings of less than .40 or items that loaded on more than one factor with a difference of less than .10 between loadings were to be removed, this would exclude all the items in the pressure/tension and effort subscales.

Discriminant and Predictive Validity. Discriminant validity can be clearly seen in the baseline analysis that shows that both the schizophrenia samples reported less IM than the healthy control group when asked to rate their motivation for attempting the arithmetic task (table 1). Predictive validity of the IMI-SR was derived from identifying improvers and nonimprovers in cognitive remediation regardless of treatment assignment. As noted, the schizophrenia remediation sample ($n = 58$) was enrolled in a cognitive remediation protocol where they were randomized to a remediation training program either with or without intrinsic motivational instructions incorporated into arithmetic-learning exercises. Using median splits, we classified subjects into 2 groups (high/low scores) on baseline IMI-SR, number of days to complete 10 sessions (treatment attendance), postarithmetic score (skill acquisition), and post-CPT-IP indices (attentional ability). We then calculated the association between the IMI-SR and each of these categorized variables in separate 2×2 tables for an odds ratio. Based on these categories, 15/58 (26%) had high baseline IMI-SR total score (>75 total score), 25/58 (43%) had high treatment attendance during the intervention phase (completed 10 sessions in less than 12 d), 21/58 (36%) had high posttest arithmetic scores (>32 total correct), and 10/58 (17%) had low posttest false positives (<8 total false positives). High IMI-SR total scores were significantly related to (a) high treatment attendance patterns (odds ratio = 4.98, $\chi^2 = 39.34$, $P = .001$), (b) high posttest arithmetic scores (odds ratio = 1.94, $\chi^2 = 21.65$, $P = .039$), and (c) fewer false positives on the CPT-IP (odds ratio = 2.8, $\chi^2 = 26.45$, $P = .026$). That is, subjects with high baseline reports of IM on the IMI-SR were nearly 5 times as likely to attend sessions on a frequent basis to achieve high treatment intensity, nearly 2 times as likely to learn more from the arithmetic exercises regardless of whether motivational instruction was incorporated into the exercises, and almost 3 times as likely to demonstrate better cognitive resource allocation on a test of vigilance.

Sensitivity to Intervention. Based on the psychometric analyses thus far, which showed effort and pressure/

tension items to be unreliable and invalid for the psychotic population, we excluded the effort and pressure/tension subscales for this analysis and only used the IMI-SR total score based on the 21 items from the interest/enjoyment, choice, and value/usefulness subscales. Paired *t* test comparisons measured the IMI-SR's sensitivity to a motivational intervention during a 4-week treatment phase. The results indicated that the IMI-SR total score changed significantly from pre to post only in the treatment condition receiving the motivational intervention (motivation group, $t = 0.619$, $P = .011$; control group, $t = 1.25$, $P = .213$). Changes in individual IMI subscales were also calculated and then correlated with change scores on the PCS, a highly related measure also sensitive to motivational intervention.⁵⁹ The change scores for the IMI total and interest/enjoyment subscale were highly correlated with PCS changes (IMI total, $r = .73$, $P = .013$; interest/enjoyment subscale, $r = .71$, $P = .018$).

Discussion

Given the emerging evidence that IM plays an important role in the psychiatric rehabilitation of people with schizophrenia,^{25,60} it is important to have a means of assessing and quantifying this construct for treatment. Scales exist to measure IM in normal and medically ill populations but not in people with schizophrenia. Thus, we set out to adapt a self-report scale to quantify IM for use in schizophrenia research. The scale started out with the 54 original items used to assess IM in normals, based on the motivational concepts of SDT.³⁵ Initial item selection, internal consistency, and test reliability analyses from a convenience schizophrenia subsample and comparative group of normals reduced the scale to 30 items for psychometric validation in a cognitive remediation treatment sample. Factor and validity analyses for the treatment sample resulted in a final recommended set of 21 items with interest/enjoyment as the core construct. The interest/enjoyment subscale in and of itself seemed to adequately capture the construct of IM, which is consistent with the motivational literature in normals.³¹ Relative to the other subscales, interest/enjoyment seems to be a purer gauge of IM as evidenced by the clearer factorial picture and significant correlations with established constructs pertinent to IM.

Nevertheless, there are merits to keeping the choice and value/usefulness subscales as part of the inventory for use in schizophrenia motivational research. The original IMI authors concluded that to have a comprehensive picture of IM, free-choice perceptions need to be assessed because choice is a strong predictor of interest/enjoyment.⁶¹ It is also particularly important to measure the perception of choice in motivation studies because having a menu of relevant options prior to and during a task improves performance on that task, regardless of whether

contingent external rewards are also provided.⁶² Furthermore, we have found in our own psychiatric studies that incorporating treatment choices is a fundamental element to moderating IM for cognitive remediation and treatment adherence.^{27,60,63} The value/usefulness subscale is widely used in internalization studies,⁵⁸ the premise being that people internalize and become self-regulating for activities that they perceive or experience as useful or valuable for themselves. This assertion will become increasingly more relevant to schizophrenia research as recent studies show that people with schizophrenia have trouble understanding reward and task utility for treatment tasks.¹⁹ Thus, measuring the perception of choice and task value provides clinical data on self-structures necessary and pertinent to motivation for treatment and task engagement in schizophrenia. For instance, additional studies with the IMI-SR might examine the potential impact that perception of choice (as provided by a menu of task options) or value/usefulness (psychoeducation about specific task utility) has on improving a patient's engagement for difficult treatments with traditionally low adherence rates.

On a theoretical note, this study found that SDT of motivation by Deci and Ryan¹⁸ generally pertains to schizophrenia, as well. The central factors for IM in SDT with normals are consistent with the factorial results presented here. This may encourage more in-depth investigations into the motivational deficits in schizophrenia via the lens of SDTs on autonomous motivation, self-regulation, and conveyance of well-internalized external motivation.¹⁸ The original IMI subscales of effort and pressure/tension, however, were ultimately excluded because we did not find these items interrelated with IM in the schizophrenia samples. Given the poor internal consistency and test-retest reliability of these subscale items for the schizophrenia sample, the lack of factorial confirmation was not entirely unexpected. However, it is still questionable whether these factors actually do not play a role in IM in schizophrenia or whether our study sample and methodology were too limited to discover these relationships. The notion of self-reported effort on cognitive tasks is fairly complicated in psychosis due to deficit syndromes, disorganization symptoms, lack of insight into actual effort put forth, and the multifaceted relationships between effortful resource allocation and performance on cognitive tasks.⁶⁴ Nearly every person in our schizophrenia sample reported that they put forth maximum effort during the cognitive tasks (ie, I tried very hard on this activity) often despite qualitative observations by the research staff to the contrary. The lack of statistical variation for this subscale (mean effort rating = 6.70, SD = 0.57) may have confounded the subscale's convergent/divergent relationships and factorial confirmation. On the other end of the spectrum, there was significant variability in affective symptoms between test-retest sessions in our

schizophrenia convenience sample, which may have been due to medication or dosage changes, fluctuation in clinical mood states, changes in familiarity or comfort levels with the research staff and surroundings, or even outside psychotherapy. As mentioned, a majority of our sample was diagnosed with schizoaffective disorder, and so measuring levels of anxiety, tension, or nervousness (ie, I felt very tense while doing this activity) is likely to contrast in comparison to measuring this domain in normals or schizophrenia without a mood disorder.⁶⁵ Furthermore, theoretically, the IMI-SR is designed to measure IM for specific tasks or time-limited treatment parameters, as the items query the perception regarding specific activities. To complement this approach, the method developed by Nakagami *et al.*²⁵ may provide a broader understandings into motivation across behaviors, treatments, and situations.²⁵

Regarding negative symptomatology and the IMI-SR, the correlation between the BPRS negative symptoms factor score and the core subscale of the IMI-SR (interest-enjoyment) was nearly significant, but conceptually, we expected to see a stronger inverse relationship between negative symptoms and a measure of motivation. Although we believe this is significant, we do not perceive this lack of relationship as a critical barometer of the IMI-SR's psychometric properties but rather a poor choice on our part to assess negative symptomatology. Our assessment of symptomatology, the BPRS, although brief and well understood as a valid symptom assessment across a broad spectrum of schizophrenia types, is an instrument that focuses on positive symptoms and generally needs to be utilized in combination with a negative symptom assessment tool (eg, Scale for the Assessment of Negative Symptoms [SANS]), if negative symptomatology is to be adequately captured. Although the psychometric properties and underlying factor structure of the BPRS are well established, the SANS contains information independent from the BPRS, and the best BPRS negative items can do is explain only approximately half of the total variance of the SANS.⁶⁶ The BPRS negative factor does not seem to be intended to evaluate motivation but a deficit syndrome (BPRS negative factor is comprised of 3 items: blunted affect, emotional withdrawal, and motor retardation), and in retrospect, it was not the best indicator of convergent validity for this study. Including a specific measure of negative symptoms may have provided us the ability to make a more accurate convergent analysis between IMI items and the construct of amotivation in schizophrenia.

In terms of predictive validity and instrument sensitivity, the 21-item IMI-SR Scale, which emerged from the factor analysis, was able to predict learning behaviors in subjects who participated in a motivational cognitive remediation study. Specifically, the subjects with high baseline reports of IM on the IMI-SR were almost 5 times as likely to attend cognitive remediation sessions on a fre-

quent basis to achieve high treatment intensity, nearly twice as likely to learn more from the remediation exercises, and almost 3 times as likely to develop better cognitive resource allocation strategies on a test of vigilance. Furthermore, when the IMI-SR was used in the cognitive remediation study, it was able to capture subjects' reactions to instructional techniques intended to enhance IM. As expected, the IMI-SR total score changed significantly from pre to post only in the treatment condition receiving the motivational intervention. In accordance with what occurs in normal populations, this increase in IM was correlated with pre-post change scores in perceived competency, a highly related construct also sensitive to motivational intervention.

Several limitations should be noted. First of all, our relatively small samples were entirely outpatient and fairly homogenous in symptom presentation and demographics with mostly schizoaffective disorder. This limits our ability to generalize these findings to a broader psychotic population, especially those without mood disorders and those with deficit syndromes, and so replication with a more diverse and larger sample is needed to establish this instrument for use in varied clinical psychotic populations. Secondly, because we did not utilize a specific measure for negative symptoms, the most important gauge of convergent validity in this sample was not adequately addressed. A larger replication trial with the SANS or the Positive and Negative Syndrome Scale may clarify the relationship between negative symptoms and the IMI-SR. In addition, as mentioned, we cannot ascertain the variability of affective symptoms between test-retest sessions in our sample, and therefore, an important component of optimal motivation for learning may have been excluded from the final version of the IMI-SR. Similar to studies with normals and performance anxiety, a more controlled investigation into affective symptoms in schizophrenia and anxiety during treatment tasks may yet find evidence to include the pressure/tension subscale into intrinsic motivational paradigms for schizophrenia and provide valuable insight into optimal affective states that inspire IM.⁶⁷ Finally, latent trait theory in instrument development (item response theory) was considered regarding statistical models for equating various instrument, patient, and study parameters and how responses may have been influenced by patient parameters not gauged by any measure used in the study (eg, location of where the patient filled out the questionnaires, general attitude toward the research assistant, expectations from the referring clinician, etc). When attempting to develop a self-report questionnaire to be completed following any treatment, this is a conundrum present in any study. Although this can be addressed with greater rigor in methodology (eg, every participant is run by the same research assistant and completes all questionnaires in a room away from the research assistant) and statistical estimations of latent

continuum, this trial did not control for these parameters during the protocol nor does the study possess enough power to calculate a theta estimate. Again, a larger study with such consideration is needed to further refine the instrument and the assessment of IM in chronic psychosis.

In conclusion, despite these limitations, the IMI-SR seems to be a reliable and valid instrument for assessing IM in outpatient schizophrenia. It is an easily administered self-report scale that requires about 5 minutes to complete and is suitable for people with at least a fourth-grade reading level.

Funding

National Institute of Mental Health (1 R03 MH071733-01A2 to J.C. and A.M.).

Acknowledgments

Drs Choi and Medalia would like to thank Joanna Fiszdon, PhD; Kellie Smith, MA; and Katie Tobin, PhD; for their assistance in data collection. National Institute of Mental Health had no further role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the article for publication.

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